Centennial WTP
Pelham, MA

# Centennial Water Treatment Plant Upgrade Evaluation and Preliminary Design

Prepared For:

**Town of Amherst**
**Amherst, MA**

November 2010

A-0233-24-01
November 17, 2010

Ms. Amy Lane
Assistant Superintendent
Department of Public Works
586 South Pleasant Street
Amherst, MA 01002

Re: **Centennial WTP Upgrade Evaluation and Preliminary Design**

Dear Ms. Lane:

In response to the Town of Amherst's request, Tighe & Bond is pleased to submit an evaluation and preliminary design for improvements to the Centennial Water Treatment Plant located on Amherst Road in Pelham, MA. The report includes recommendations for improvements to the facility's process, structural, architectural, HVAC, and electrical systems.

# Executive Summary

The Centennial Water Treatment Plant was designed by Tighe & Bond and constructed in the early 1980's. With the exception of the addition of baffles to the water storage reservoir, no major modifications have been made to the plant since its construction. As a result, most of the existing equipment is approaching the end of its service life or has deteriorated and is in need of replacement. Tighe & Bond visited the site, discussed needs and preferences with the Town, contacted vendors, and developed recommendations, a preliminary design, and an opinion of probable cost to rehabilitate the plant. Our recommendations are briefly described below.

**Process improvements**

- Upgrade the Roberts treatment units, including replacing the tube settlers, replacing the filter media, painting the tanks, and replacing the existing surface wash system with an air scour system.
- Install a UV primary disinfection system
- Install a flow distribution header in the raw water splitter box
- Replace raw water, backwash control, effluent, and drain valves on the Roberts units. Consider replacing the existing pneumatic valve actuators with electric actuators and eliminating the compressed air system.
- Evaluate and replace hypalon baffles in chlorine contact chamber
- Install a magnetic flow meter on the raw water line. The raw water flow rate will be controlled by pacing the pumps using the existing VFDs based on the flow signal.
- Install a turbidity meter and pressure level transducers

**HVAC/Electrical Improvements**

- Replace the HVAC system
- Replace the motor control center and generator
- Replace interior and exterior lighting

**Building Improvements**

- Repair skylights
- Replace gutters and downspouts
- Paint the workroom floor

**Chemical Feed Improvements**

- Upgrade the chlorine and ammonia rooms to meet current safety recommendations
- Relocate the polymer transfer pump and make associated piping modifications

**External Improvements**

- Install a sewer in Amherst Road connecting the plant to the Amherst sewer system
- Abandon existing septic system
- Install underground storage tanks at the plant to receive spent backwash water and clarifier blowdown water. This would allow elimination of the existing lagoons and increase the residuals capacity of the plant.
- Replace the raw water pump station motor control center and rooftop ventilation system
- Replace the existing Amherst Road control valve and booster pump with a new package pump/flow control valve station

Our opinion of probable project cost, for the listed recommendations, not including low priority items, is $2,100,000. Low priority or separately budgeted items are outlined and estimated in Section 5 of the Report. The detailed opinion of probable cost is in Appendix H.

# Acknowledgements

We wish to thank the Town of Amherst for its assistance throughout the project and the development of this report. We especially acknowledge the assistance provided by your staff during the field visits and in providing requested information over the phone and through email.

This report was prepared by Tighe & Bond personnel under the general supervision of Peter Valinski, P.E., Vice President. John McClellan, PhD, P.E., served as project manager. The field inspection team consisted of Wayne Harju, P.E. (electrical/HVAC) and John Frawley, P.E. (architectural/structural). Christina Stauber assisted with the field inspection and in preparing the final report.

Following the Town's review of this report, we would be pleased to meet with you to discuss the implementation of the recommendations developed and future update of the database.

Very truly yours,

**TIGHE & BOND, INC.**

Peter M. Valinski, P.E.
Vice President

John N. McClellan, PhD, P.E.
Associate

Enclosures

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## Appendices

# Section 1
# Introduction

The Centennial Water Treatment Plant (Centennial WTP) located off of Amherst Road in Pelham, was constructed in 1981, and treats water from the Hill and Hawley Reservoirs (WTP is shown in Photo 1-1). The plant is one of two surface water treatment plants that supply water to Amherst. Tighe & Bond assessed the condition of the plant and evaluated alternatives for rehabilitating the plant building and equipment.

**Photo 1-1:** Centennial Water Treatment Plant

## 1.1 Plant Description

The Centennial Water Treatment Plant was designed by Tighe & Bond in 1981. The plant building is a Republic pre-engineered steel frame structure with a metal roof and sidewall panels. The plant has a below-grade cast-in-place concrete filtered water storage reservoir that serves as the foundation for the filter room. The chemical storage/utility room has a slab-on-grade foundation. In 1993 the water storage reservoir was modified to include three hypalon membrane baffles at the inlet of the reservoir to provide adequate chlorine contact time. The hypalon baffles project was also designed by Tighe & Bond. The building has been in service for almost 30 years with no other significant upgrades.

A flow diagram of the plant is presented in Figure 1-1, and a site plan is presented in Figure 1-2. The primary process equipment consists of three package filtration units manufactured by Roberts Filter Group. Each unit consists of two flocculation basins, a sedimentation basin with inclined tube settlers, and a dual media anthracite over silica sand filter, installed within a 46 foot long by 10 foot wide steel tank, with the treatment unit processes separated by bulkheads. The nominal capacity of each unit is 350 gpm, translating to a plant capacity of 1.0 MGD with two units operating and a redundant standby unit, for a total plant capacity of 1.5 MGD with three units operating. The treatment process also includes equipment for feeding coagulant chemicals, and gas-to-solution chlorination and chloramination systems. Polymer is the only coagulant chemical used, at an average dosage of approximately 6.5 mg/L.

Spent backwash water is discharged to a settling lagoon system, consisting of two unlined earthen bermed basins connected in series. Backwash water is discharged to the upstream basin. The upstream basin overflows to the downstream basin, and the downstream basin overflows to the Harris Brook. The solids are removed from the basins using a loader approximately every two years. The capacity of the washwater basins to receive residual solids is limited, thus limiting the amount of coagulant that can be utilized in the treatment process.

The plant typically experiences episodes of high color raw water during the summer. The organics removal effectiveness during these episodes has been relatively poor, resulting in high trihalomethane (THM) and haloacetic acid (HAA) monitoring results in the distribution system. The Town has occasionally removed the plant from service during the summer as a result of the poor organics removal effectiveness during high color episodes.

## 1.2 Potential Improvements

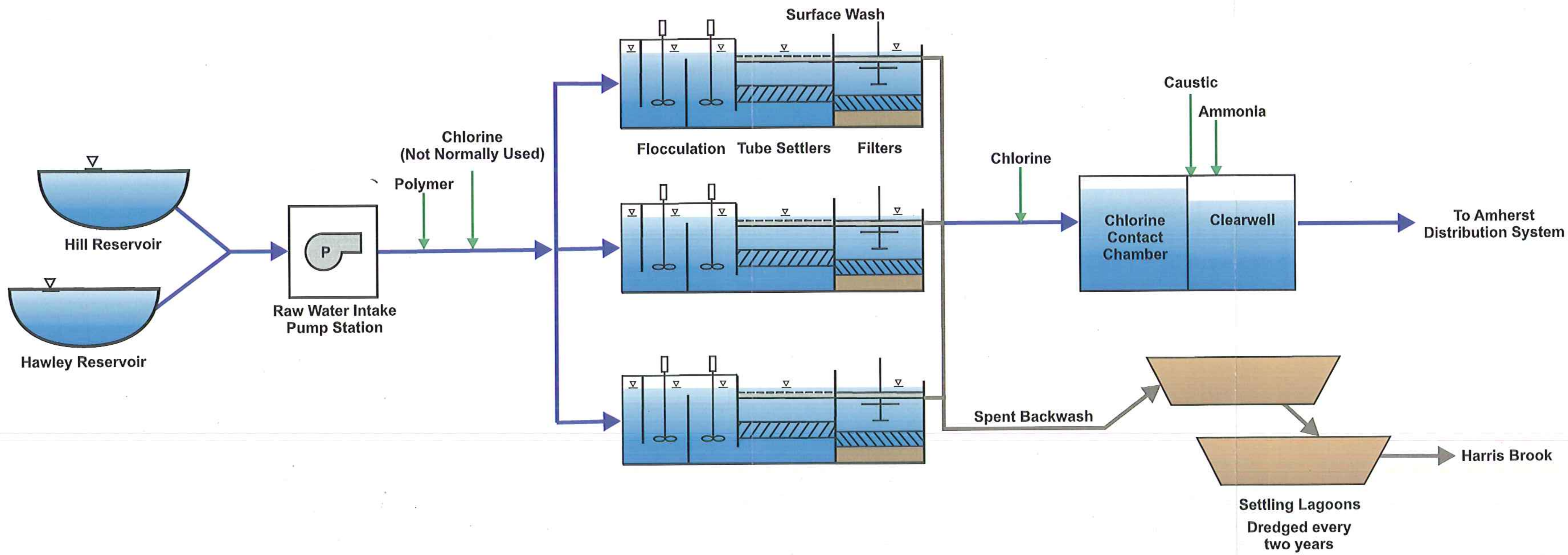
The following potential improvements were identified:

- Treatment process upgrades, including painting the Roberts treatment units, replacing the tube settlers, filter media, and underdrain systems and installing air scour systems; and installation of a UV primary disinfection system.
- Building upgrades, including repairing the skylights and interior siding, HVAC and electrical
- Installation of a sewer in Amherst Road connecting to the Amherst sewer system
- Rehabilitation of the Amherst Road flow control valves and booster pump

The Town intends to construct improvements to the plant in FY 2012. This report provides recommendations, preliminary design information, and an opinion of probable cost for the proposed improvements.

# Figure 1-1
# Centennial Water Treatment Plant

## Existing Process Schematic




Tighe&Bond

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OCTOBER 2010

**Legend**

Existing 12" main

Parcels

0 150 300 600 Feet

1 inch = 300 feet

**FIGURE 1-2**
**SITE PLAN**

**Pelham, Massachusetts**

Tighe&Bond

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# Section 2
# Previous Studies

As a part of this evaluation, previous studies were reviewed and are summarized in this section. These studies include the following:

- January 2001 *Facility Plan Update*
- April 2004 *Centennial Water Treatment Plant Options – Phase 1 Conceptual Evaluation*
- April 2005 *Comments Regarding Full Scale Test of PACL Coagulant at Centennial WTP*
- September 2008 *Centennial Water Treatment Plant – Coagulant Testing*

The report titled *Facility Plan Update*, dated January 2001, provided an update to the *Water System Facilities Plan* completed in 1983. The report included comments regarding the performance of the Centennial WTP. Operational data from the plant indicated that the plant was adequately removing turbidity in compliance with the Enhanced Surface Water Treatment Rule. During FY00, the Centennial WTP produced an average turbidity of 0.11 NTU and never exceeded 0.20 NTU. The turbidity removal of the plant continues to meet regulatory requirements.

Tighe & Bond provided the Town of Amherst with a conceptual evaluation of the Centennial Water Treatment Plant in April 2004, in a memorandum titled *Centennial Water Treatment Plant Options – Phase 1 Conceptual Evaluation.* Appendix A contains a copy of the memorandum text. The memorandum discusses the factors limiting the flow rate through the plant, including residuals settling rates and the performance of the Roberts Filter units. At the time (and still at present day), the plant performance begins to deteriorate when the flow rate exceeds approximately 200 gpm per filter unit (400 gpm for two units, and 600 gpm for all three units). The 2004 evaluation considered options for improving the plant performance so that the full capacity of the plant could be utilized. Turbidity removal, color removal, and disinfection byproduct (DBP) formation were evaluated as a part of this study. Tighe & Bond evaluated five upgrade alternatives for the WTP, which included combinations of enhanced coagulation, UV disinfection, contaclarification, membrane filtration and MiEx system pretreatment. Tighe & Bond recommended consideration of supplementing polymer with an aluminum salt coagulant (e.g. aluminum sulfate), because it is likely to increase the removal of dissolved organic material.

The results of coagulant testing conducted in August 2004 were summarized in a memorandum titled *Comments Regarding Full Scale Test of PACL Coagulant at Centennial WTP* and is included in Appendix A. Holland Chemical's PCH 180, a polyaluminum chloride (PACl) coagulant, was evaluated both singularly and in combination with the Nalco polymer coagulant that was currently used. The PACl was found to be very effective in the jar tests as a coagulant for the removal of organics and turbidity. A disadvantage of the PACl coagulant was that it produced approximately double the amount of residuals in comparison to the Nalco coagulant.

The results of additional coagulant testing were summarized in the memorandum titled *Centennial Water Treatment Plant – Coagulant Testing*, submitted to the Town of Amherst in September 2008 (Appendix A). The memo described a coagulant comparison test that was conducted in order to allow the Town of Amherst to consider substituting Polydyne coagulant for the Nalco coagulant that was currently used. Based on visual observations, the Polydyne polymer appeared to produce higher levels of sludge and flocculent in comparison to the Nalco coagulant, while still providing the same level of water clarity. In the interest of minimizing sludge production, the Town of Amherst preferred to continue the use of Nalco coagulant.

# Section 3
# Objectives

Based on the findings of previous studies, review of historical data, and our conversations with the Town, the following problems and items requiring improvements are noted:

- Treatment process
  - Turbidity performance deteriorates when the flow rate exceeds about 2/3 of the nominal capacity of the Roberts units
  - Organics removal is poor, resulting in high TTHM and HAA5 formation
  - Residuals handling lagoons have limited capacity
- Process Equipment
  - Coating systems on the Roberts unit tanks are deteriorated
  - Raw water and filter effluent flow control valves are not accurate
  - Flow splitter box does not accurately distribute flow
  - Polymer transfer pump is in an inaccessible location
- Distribution infrastructure
  - Amherst Road flow control valve/pump station has reached the end of its useful life
- Plant building
  - Skylights leak and are in need of repair
  - Gutters and downspouts leak and need to be replaced
  - HVAC system is approaching the end of its useful life
  - Electrical system is in need of upgrade
  - Chlorine and ammonia rooms do not meet current safety recommendations

These problems were evaluated and are discussed, along with recommendations, in Section 4.

# Section 4 Evaluation/Recommendations

The recommended improvements to the Centennial WTP are depicted in Figures 4-1 through 4-5. Building improvements are presented in Figure 4-1, process improvements are in Figure 4-2, modifications to the Roberts filter units are in Figure 4-3, additional piping modifications are in Figure 4-4, and modifications to the splitter box are in Figure 4-5. All of the recommendations are described in this Section, and are summarized below:

1. Upgrade the Roberts treatment units, including replacing the tube settlers, replacing the filter media, painting the tanks, and replacing the existing surface wash system with an air scour system.
2. Install a UV primary disinfection system
3. Install a flow distribution header in the raw water splitter box
4. Evaluate and, if necessary, replace the hypalon baffles in the chlorine contact chamber
5. Replace raw water, backwash control, effluent, and drain valves on the Roberts units. Consider replacing the existing pneumatic valve actuators with electric actuators and eliminating the compressed air system.
6. Install a magnetic flow meter on the raw water line. The raw water flow rate will be controlled by pacing the pumps using the existing VFDs based on the flow signal.
7. Replace the HVAC system
8. Replace the motor control center and generator
9. Replace interior and exterior lighting
10. Replace gutters and downspouts
11. Repair skylights
12. Paint the workroom floor
13. Upgrade the chlorine and ammonia rooms to meet current safety recommendations
14. Relocate the polymer transfer pump and make associated piping modifications
15. Install a sewer in Amherst Road connecting the plant to the Amherst sewer system
16. Install underground storage tanks at the plant to receive spent backwash water and clarifier blowdown water. This would allow elimination of the existing lagoons and increase the residuals capacity of the plant.
17. Replace the raw water pump station motor control center and rooftop ventilation system
18. Replace the existing Amherst Road control valve and booster pump with a new package pump/flow control valve station

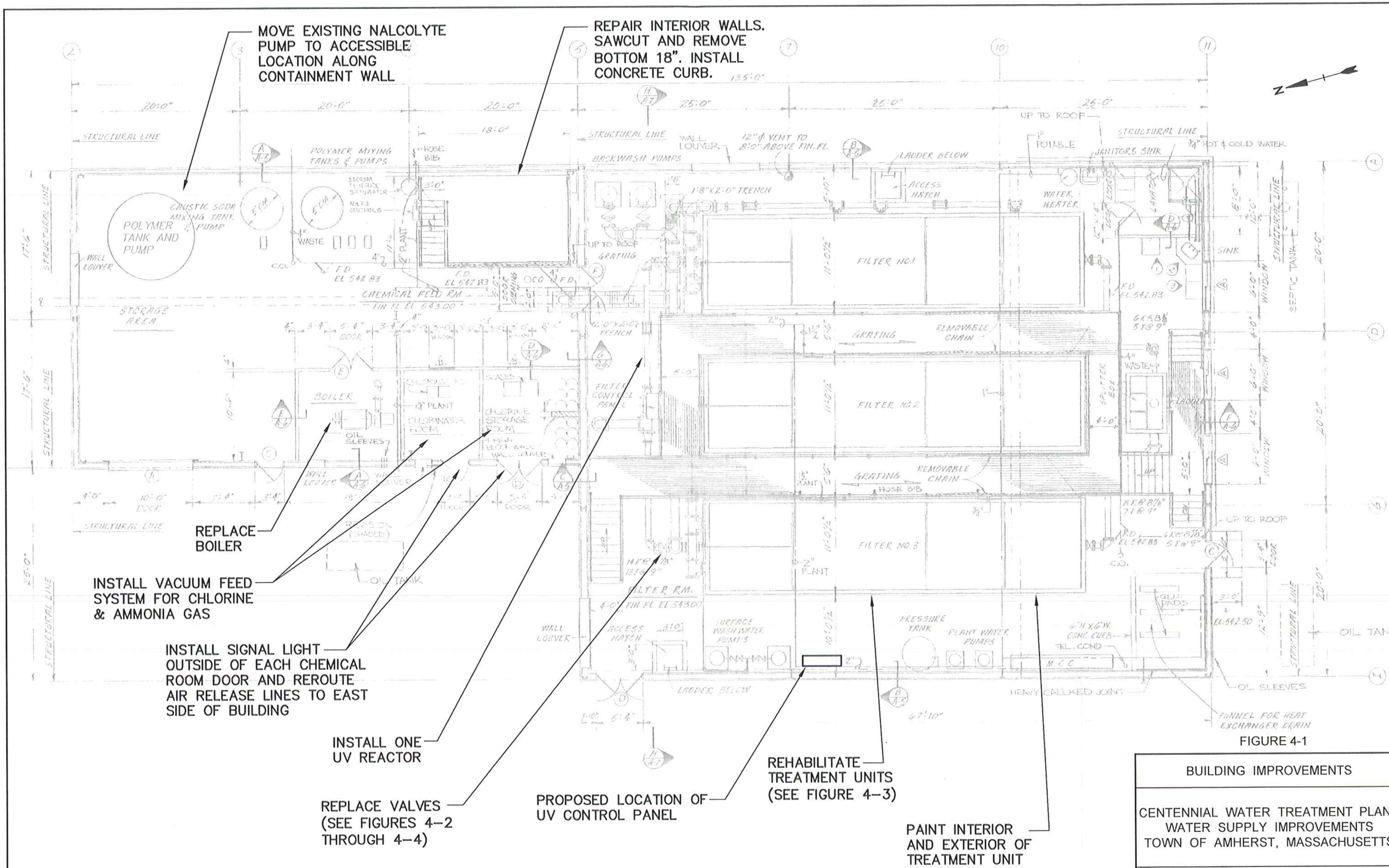


FIGURE 4-1

BUILDING IMPROVEMENTS

CENTENNIAL WATER TREATMENT PLANT
WATER SUPPLY IMPROVEMENTS
TOWN OF AMHERST, MASSACHUSETTS

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: 3/32"=1'-0" DATE: SEPTEMBER 2010

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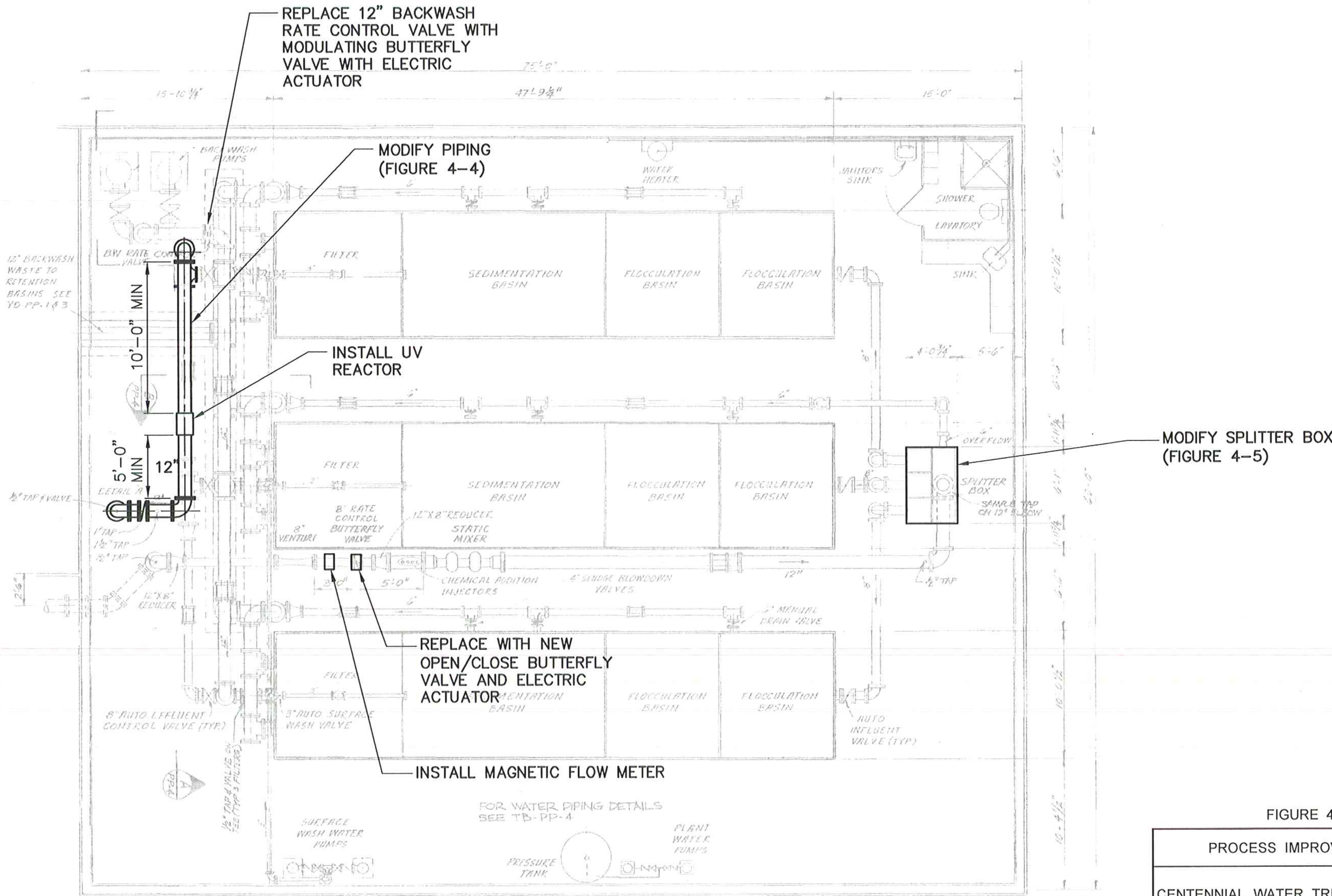


FIGURE 4-2

PROCESS IMPROVEMENTS

CENTENNIAL WATER TREATMENT PLANT
WATER SUPPLY IMPROVEMENTS
TOWN OF AMHERST, MASSACHUSETTS

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: 1/8"=1'-0" DATE: SEPTEMBER 2010

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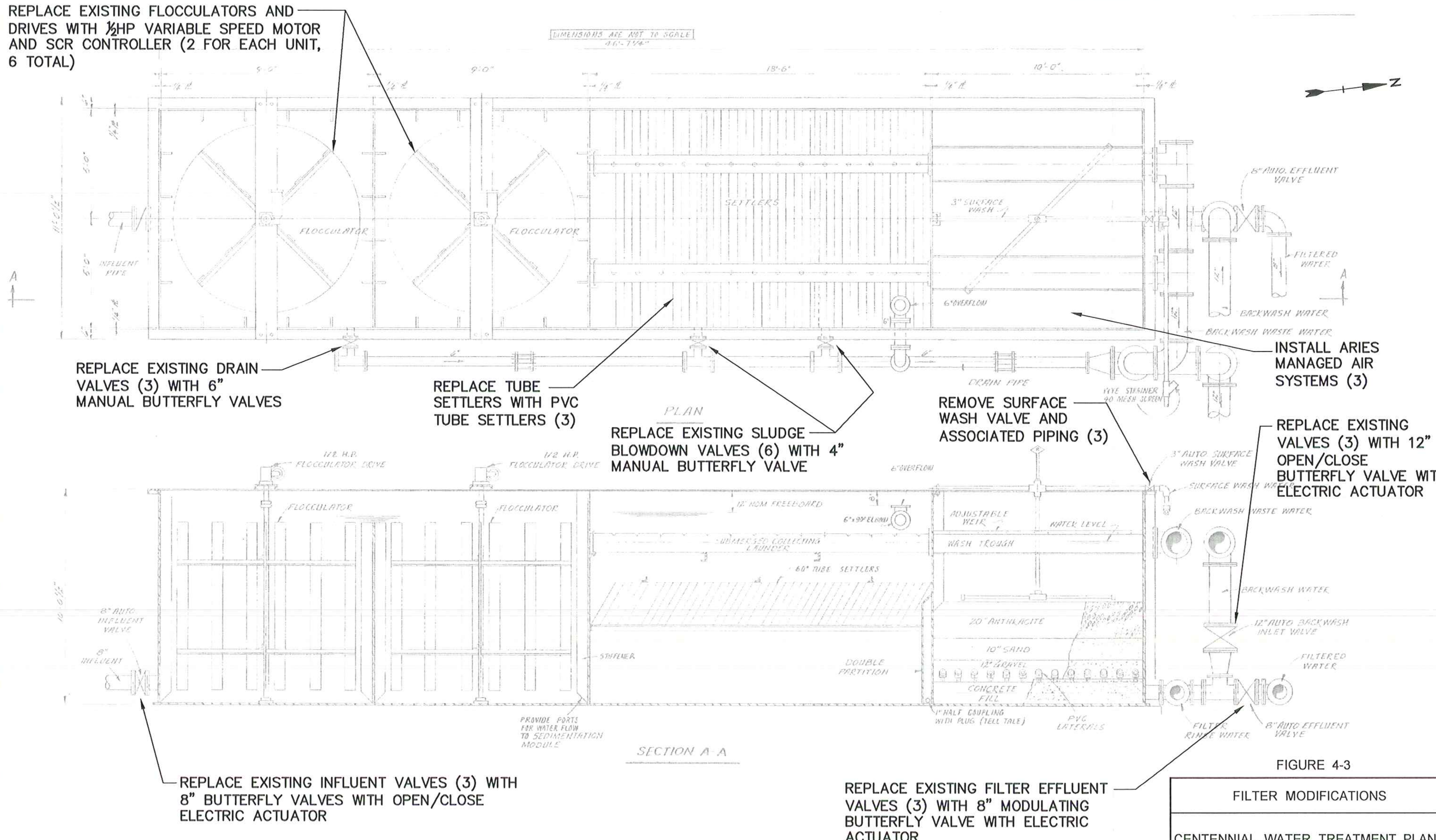


FIGURE 4-3

FILTER MODIFICATIONS

CENTENNIAL WATER TREATMENT PLANT
WATER SUPPLY IMPROVEMENTS
TOWN OF AMHERST, MASSACHUSETTS

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASSACHUSETTS

SCALE: 1/4"=1'-0" DATE: SEPTEMBER 2010

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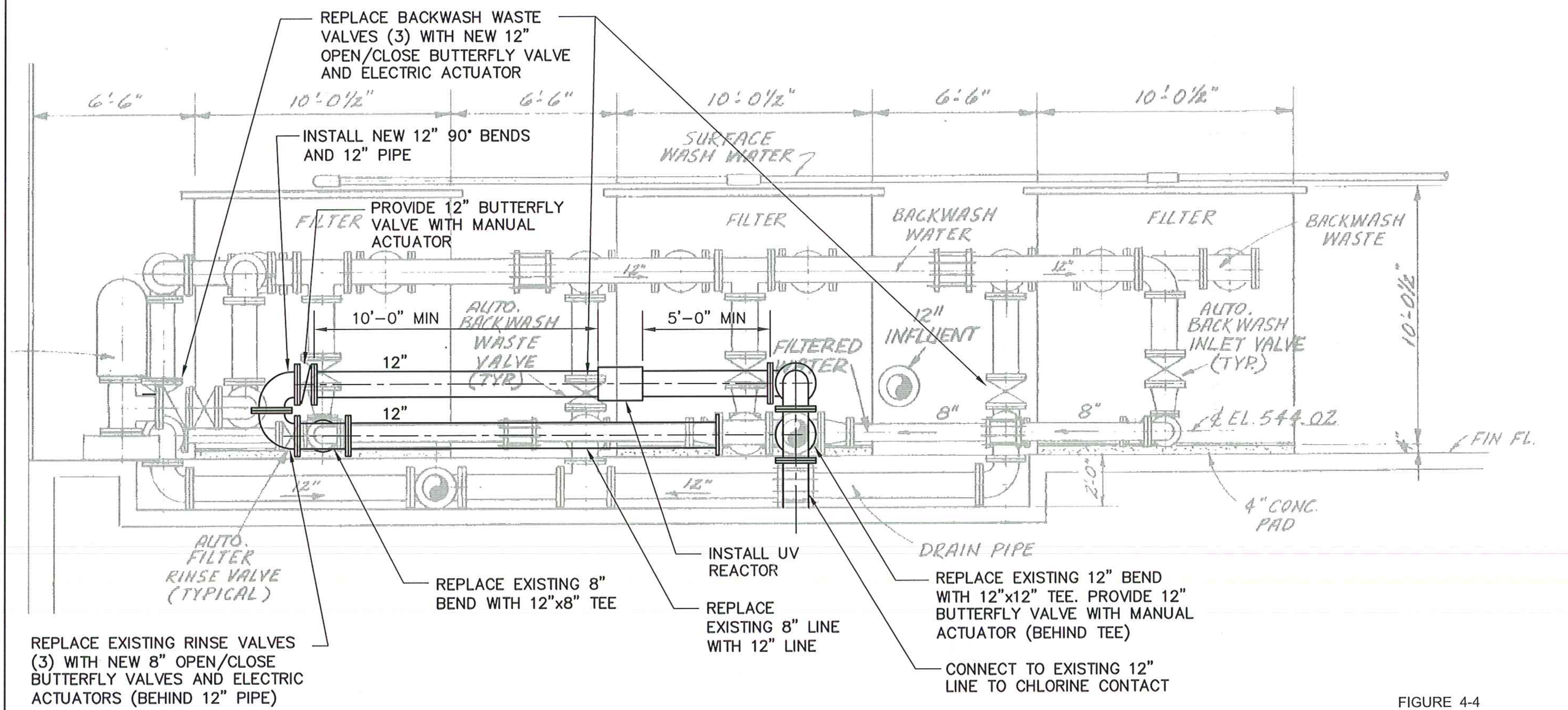


FIGURE 4-4

| |
|---|
| PIPING MODIFICATIONS |
| CENTENNIAL WATER TREATMENT PLANT<br>WATER SUPPLY IMPROVEMENTS<br>TOWN OF AMHERST, MASSACHUSETTS |
| TIGHE & BOND CONSULTING ENGINEERS<br>WESTFIELD, MASSACHUSETTS<br>SCALE: 1/4"=1'-0" DATE: SEPTEMBER 2010 |

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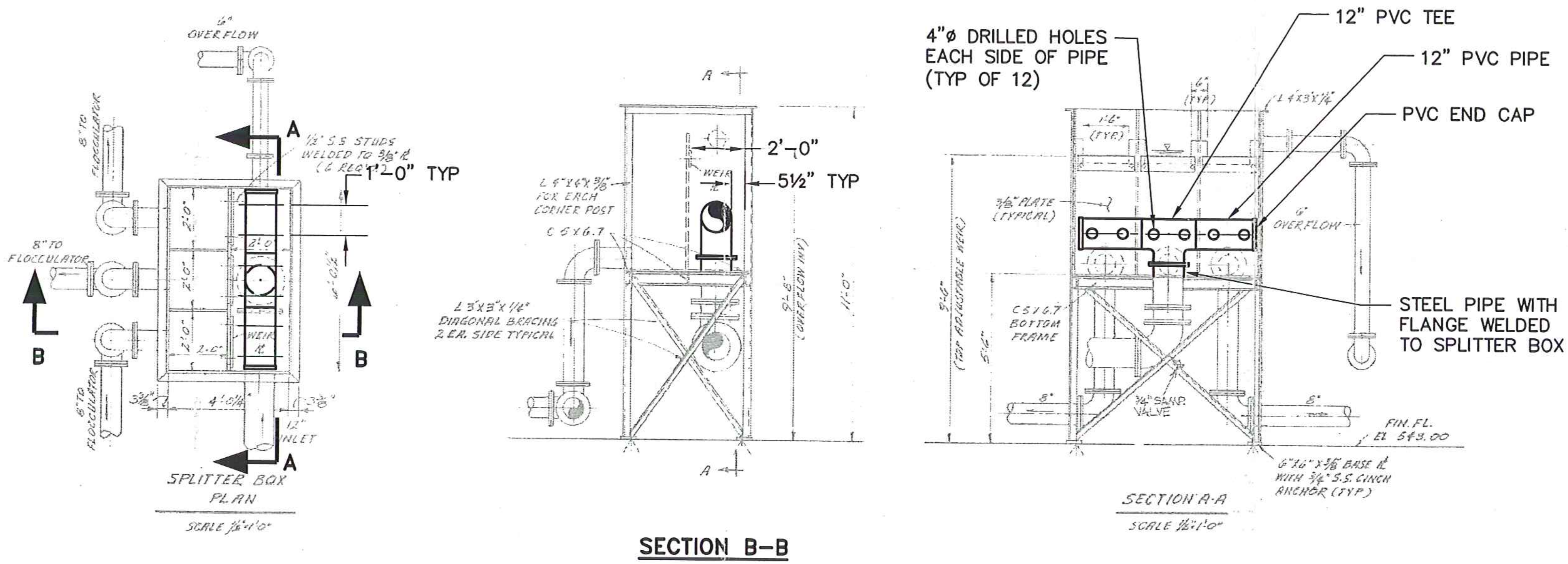


FIGURE 4-5

| |
|---|
| SPLITTER BOX MODIFICATIONS |
| CENTENNIAL WATER TREATMENT PLANT<br>WATER SUPPLY IMPROVEMENTS<br>TOWN OF AMHERST, MASSACHUSETTS |
| TIGHE & BOND CONSULTING ENGINEERS<br>WESTFIELD, MASSACHUSETTS |
| SCALE: 1/4"=1'-0" DATE: SEPTEMBER 2010 |

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## 4.1 Roberts Units

The primary process equipment at the Centennial WTP consists of three package filtration units manufactured by Roberts Filter Group. Each unit consists of two flocculation basins, a sedimentation basin with inclined tube settlers, and a dual media anthracite over silica sand filter, installed within a 46 ft. long by 10 ft. wide steel tank, with the treatment unit processes separated by bulkheads. The nominal capacity of each unit is 350 gpm, translating to a plant capacity of 1.0 MGD with two units operating and a redundant standby unit, for a total plant capacity of 1.5 MGD. The package filtration units were evaluated and Roberts was contacted in order to provide vendor quotes for rehabilitating the units. The quotes are provided in Appendix B. Recommendations for rehabilitation include the following:

- Replacement of flocculators and drives
- Replacement of the tube settler inserts
- Replacement of the filter media
- Painting the tanks

### 4.1.1 Flocculators and Drives

The existing flocculators and drives are in fair condition and are operational (Photo 4-1). However, at almost 30 years old, they are approaching the end of their useful lives and proactive replacement is recommended as part of the proposed major process equipment upgrade. We recommend that all six vertical flocculators, corresponding motors, and SCR controllers be replaced with new units mounted on the existing supports.

### 4.1.2 Tube Settlers

The existing tube settlers are in poor condition, and are severely degraded, particularly in Treatment Unit No. 2 (Photo 4-2). The manufacturer recommends replacement of the existing tube settlers with 24-inch high PVC tube settlers that would be supported by the existing tube settler support rack.

**Photo 4-1:** Existing Flocculators in Treatment Unit No. 2

**Photo 4-2:** Tube Settlers in Treatment Unit No. 2

### 4.1.3 Replacement of Filter Media and Gravel

Similar to other process components, the existing filter media and gravel support systems are in operable condition but have not been replaced in almost 30 years. Replacement of all filter gravel layers as well as the anthracite and sand media is recommended in order to restore the Roberts units to their original flow capacities. We recommend replacing the media and gravel support systems in kind – no modifications to the existing design are recommended.

### 4.1.4 Backwash Systems: Surface Wash or Air Scour

Two alternatives are available for upgrading the backwash system: replacing the existing surface wash system with a new surface wash system or replacing it with an air scour system. Based on our experience, we recommend an air scour system as the most effective from the standpoint of increasing the filter run volumes and minimizing the amount of water used for backwashing. However, air scour systems will require a large blower, making this alternative more expensive than the surface wash alternative. Roberts has provided pricing for a surface wash alternative and an air scour alternative. These alternatives are described as follows.

- UNISWEEP Filter Wash Agitators: this system is similar existing surface wash system
- Aries Air Managed Scour System: the recommended Aries system is a drop-in type air scour system that delivers air from a blower to the filter media. One module will be required for each filter bay. The components are fabricated of stainless steel. The Roberts Aries system is depicted in Photo 4-3 and vendor information is provided in Appendix B.

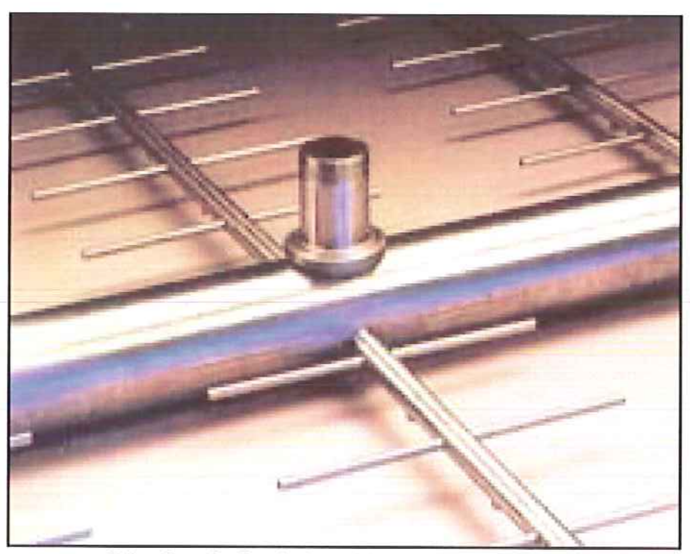


**Photo 4-3:** Aries Air Scour System

## 4.2 Flow Splitter Box

The flow splitter box (Photo 4-4 and 4-5) is located at the head of the filter units and splits the influent flow in thirds, in order to provide even flow through each filter. However, the Town of Amherst has indicated that the splitter box does not provide uniform flow to the filters and would like to make improvements to the system.

**Photo 4-4:** Existing Splitter Box Inflow Design

**Photo 4-5:** Flow Splitter Box

The current splitter box design allows water to enter a chamber. At the top of the chamber, the water is split into three flows via divider panels. Flow is directed over three weirs to the individual filter units. If the water surface is level and the weirs are at the same elevation, the system will deliver equal flow to each filter. The water enters the chamber in the center, aligned with the middle splitter box. This alignment appears to cause the water to boil slightly in the center, resulting in a slightly higher water level at the center weir resulting in more flow to the center Roberts unit.

To improve the uniformity of the flow to the filters, it is recommended that a flow distribution header be installed in the splitter box. The flow distribution header will consist of a PVC pipe with several evenly spaced outlets that will equalize the flow between the three filter units.

## 4.3 Valves

The automatic valves in the Centennial Water Treatment Plant are currently operated with Baily pneumatic valve actuators (Photo 4-6) which are controlled by compressed air generated in an air compressor located on the south side of the treatment room. The accumulator tank, air piping systems, and valve actuators are not tightly sealed and consume a considerable amount of air, resulting in excessive energy consumption by the compressor. At least one of the valves sticks as well. We recommend replacing the valves and actuators, particularly the ones that are known to cause problems.

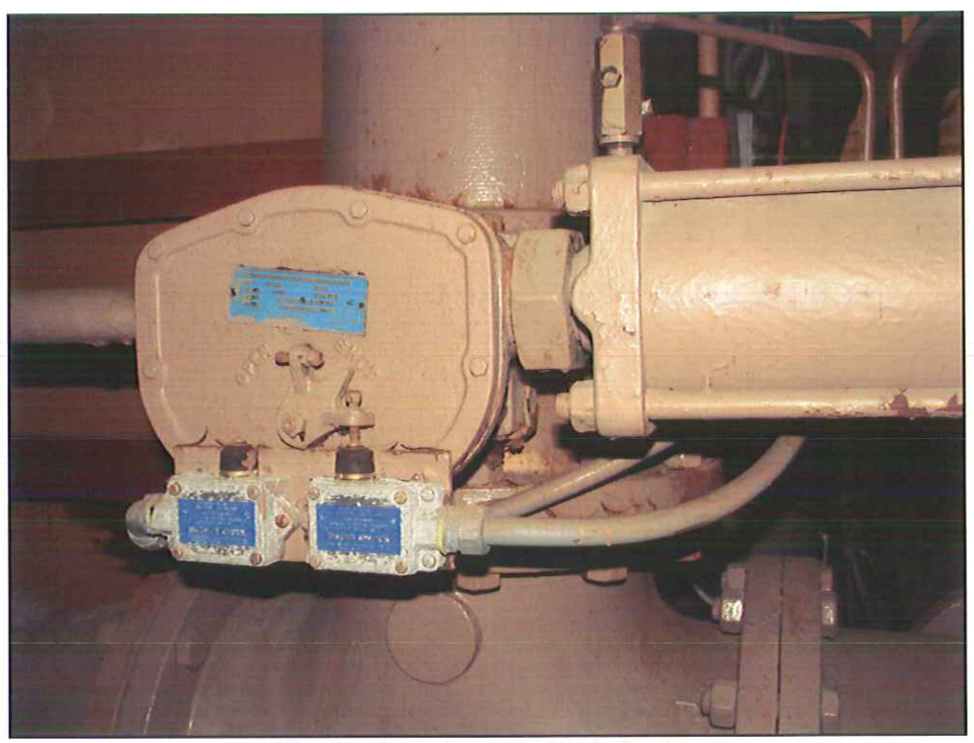


**Photo 4-6:** Pneumatic Actuator

Two options are available for replacing the valves:

1. Replace the entire system of automatic valves with new butterfly valves with electric actuators. Completely remove the air compressors and replace any other pneumatically controlled equipment with electric equipment.
2. Preserve the existing compressed air system, but replace all valves or select "trouble" valves with new pneumatically operated valves, and replace leaking tubing. Retain the existing air compressors, which are in good condition, but replace the accumulator tanks.

We recommend consideration of electric actuators, which would provide a more modern system that would allow eliminating the air compressor and accumulator tank. Figures 4-2 through 4-4 identify the valves to be replaced. Advantages of electric and pneumatic actuators are presented in Table 4-1. Vendor information is available in Appendix C.

**TABLE 4-1**
Advantages of Pneumatic and Electric Actuators

| Pneumatic Actuators | Electric Actuators |
|---|---|
| Pneumatic actuators are less costly | Eliminates air leaks, potential energy savings compared to existing pneumatic system, and eliminate cost of replacement of air compressor |
| Ability to program valves to shut off or turn on in the case of a power outage, and ability to operate the valves during the power outage without the standby generator | Would decrease overall system complexity by eliminating compressed air system |
| The Town has found the existing pneumatic actuator system to be very reliable compared to electric actuators at the Atkins WTP | Reliability of electric actuators has improved- we have designed many trouble-free installations |
| Pneumatic actuators are smaller and take up less space in the crowded filter area | Would allow elimination of air lines, and require less floor space due to elimination of air compressors and accumulator tanks |

Table 4-2 provides information and summarizes our recommendations relative to valves associated with the Roberts treatment units. We recommend providing a modulating backwash rate control valve in order to provide a low flow for filling up the filter units, or alternatively, reusing the existing surface wash pumps for this purpose. The surface wash pumps could remain in place and continue to be used solely for filling the filters. For budgeting purposes, it is assumed that a new backwash rate control valve will be provided.

**TABLE 4-2**
Recommended Replacement Valves

| | | | Actuator Operation | | |
|---|---|---|---|---|---|
| **Valve** | **Qty.** | **Butterfly Valve Size (in)** | **Existing** | **Proposed** | **Remarks** |
| Backwash Rate Control Valve | 1 | 12-inch | Automatic Open/Close | Automatic Modulating | Controls backwash rate – no VFD |
| Raw Water Valve | 1 | 8-inch | Automatic Modulating | Automatic Open/Close | Replace existing rate control valve - VFD will control raw water flow - |
| Sludge Blowdown Valves | 6 | 4-inch | Manual | Manual | Manual valve |
| Manual Drain Valve | 3 | 6-inch | Manual | Manual | Manual valve |
| Automatic Influent Valve | 3 | 8-inch | Automatic Open/Close | Automatic Open/Close | Replace existing automatic valve |
| Automatic Surface Wash Valve | 3 | 3-inch | Automatic Open/Close | None | Remove – replace surface wash with air scour system |
| Automatic Effluent Control Valve | 3 | 8-inch | Automatic Modulating | Automatic Modulating | Replace existing automatic valve |
| Automatic Backwash Inlet Valve | 3 | 12-inch | Automatic Open/Close | Automatic Open/Close | Replace existing automatic valve |
| Automatic Backwash Waste Valve | 3 | 12-inch | Automatic Open/Close | Automatic Open/Close | Replace existing automatic valve |
| Auto Filter Rinse Valve | 3 | 8-inch | Automatic Open/Close | Automatic Open/Close | Replace existing automatic valve |

## 4.4 Plant Building

The plant building is a steel frame pre-engineered structure constructed in the early 1980s. While the building shell is still functional, dents and rust stains are evident in some locations, and several pieces of equipment are approaching the end of their service lives at almost 30 years old. Therefore, proactive replacement of these systems is recommended as part of a major plant upgrade. The recommended building upgrades include the following:

- Repair and raise skylights
- Replace gutters and downspouts
- Repair or partially replace the corroded areas at the bottom of the interior wall panels
- Replace the existing heating and ventilation systems
- Upgrade the electrical equipment
- Replace interior and exterior lighting

### 4.4.1 Interior Wall Panels

The interior wall panels are showing signs of rust in several areas along the floor (Photo 4-7). Rather than replace the entire panels, which would require removal and reattachment of all the equipment located on the walls, we recommend saw cutting and removing the bottom 18 inches from the interior wall panels and installing an 8 inch wide by 16 inch high concrete curb below the wall. Installing a curb will prevent future rusting of the walls and provide a permanent solution to the problem.

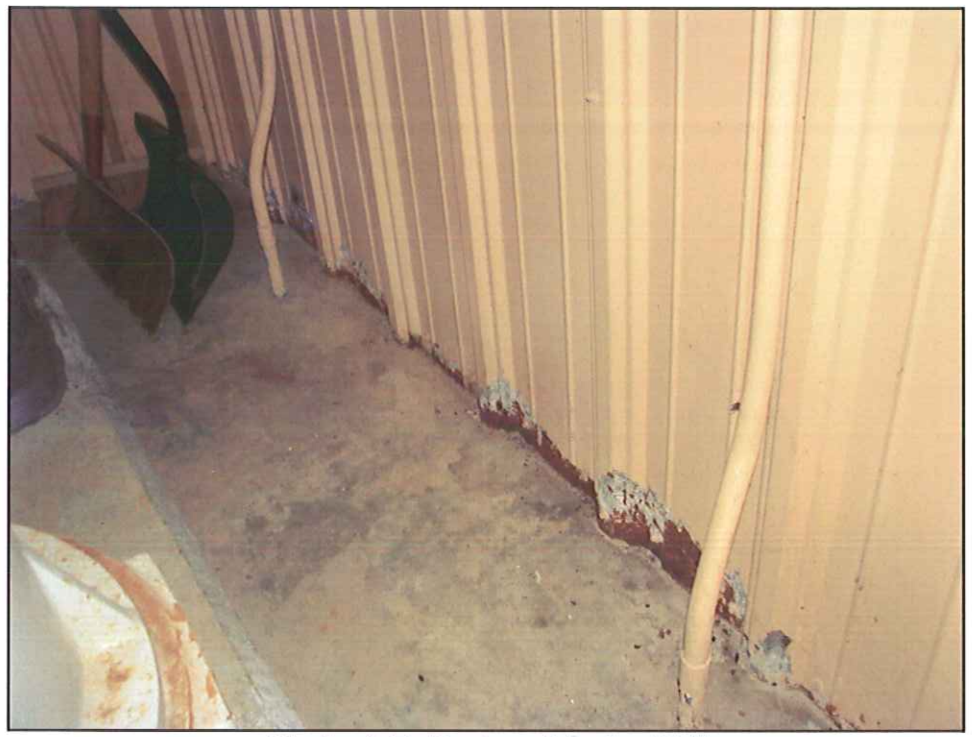


**Photo 4-7:** Rust on Interior Wall

### 4.4.2 Workroom Floor

The existing paint is deteriorated (Photo 4-8). Painting the workroom floor is recommended.

### 4.4.3 HVAC

The boiler is in poor condition. The unit heaters, fans louvers, and ventilators are in fair condition. We recommend replacing the following equipment:

- Boiler and associated equipment
- Unit heaters
- Louvers
- Roof ventilators
- Roof fans
- Hydronic piping: most of the hydronic piping is in good condition, except for select sections, which should be replaced.

**Photo 4-8:** Deteriorated Paint on Workroom Floor

### 4.4.4 Electrical

The electrical equipment was found to be in fair condition. The lighting is old and the exit signs are not lit. We recommend replacing the following equipment:

- Motor Control Center
- Generator
- Interior lighting, including rewiring
- Exterior lighting, including rewiring
- Exit lights and wiring
- Emergency lights and wiring

## 4.5 Pumps and Chemical Feed Systems

The Centennial Water Treatment Plant utilizes a gas feed system for chlorine and ammonia for disinfection. Polymer is added into the system before the Roberts units and chlorine is added just before the chlorine contact chamber. Ammonia is added after the chlorine contact chamber, along with caustic.

### 4.5.1 Chlorinator and Ammonia Rooms

The chlorine and ammonia rooms are isolated from the rest of the building and can only be accessed from the outside, through doors that are properly labeled to identify the contents. Each room contains an air vent and louver for air circulation, as well as a unit heater. Lighting is backed up by the standby generator. The following measures are recommended to improve the safety of the chlorinator and ammonia rooms:

- The chlorine and ammonia pressure relief lines are currently routed through the exterior wall and discharge near the doors, creating a hazard for anyone trying to evacuate or approach the rooms in the case of a leak (see Photo 4-9). In order to provide a safe escape route, the release lines should be rerouted to the other side of the building, away from any air intakes.
- Install bright signal lights outside of each room to alert a visitor to chlorine and ammonia releases, in order to ensure that people at the site are aware of any existing hazards. The signal lights should activate when levels exceed OSHA permissible exposure limits, as follows:
  - Chlorine – 1 ppm
  - Ammonia – 50 ppm
- Install a windsock to provide wind direction information. The windsock should be visible from the street approach to the building.
- Upgrade the gas feed system to a vacuum system. A vacuum system would eliminate the sections of stainless steel tubing that currently operate under pressure and are prone to failure/leaks by installing the regulator directly onto the gas cylinder. The existing systems are depicted in Photo 4-10 and Photo 4-11. Vendor information is available in Appendix D.
- In addition to the identity of the chemical, hazard information should be posted on the doors to alert emergency responders in accordance with the requirements of NFPA 704M, as follows (H:Health (blue), F:Fire (red), R:Reactivity (yellow)):
  - Chlorine – H:3, F:0, R:0, Special: OX
  - Ammonia - H:3, F:1, R:0
- Emergency response training should be implemented for the Water Department or the Fire department for response to chlorine and ammonia releases.
- Provide a chlorine "A-kit" used to plug releases in chlorine cylinders.
- Upgrade the electrical equipment in the Ammonia Room to explosion proof.

### 4.5.2 Polymer Transfer Pump

Several of the chemical feed pumps were recently replaced and are in good condition. The polymer transfer pump is located behind the Nalcolyte Polymer tank, and is difficult to access (see Photo 4-12). The pump should be relocated to the south side of the secondary containment structure, and installed on a shelf, similar to the caustic pump (Photo 4-13). The relocation should only require minor piping modifications.


**Photo 4-9:** Exterior of Chlorinator and Ammonia Rooms

**Photo 4-10:** Chlorinator Room

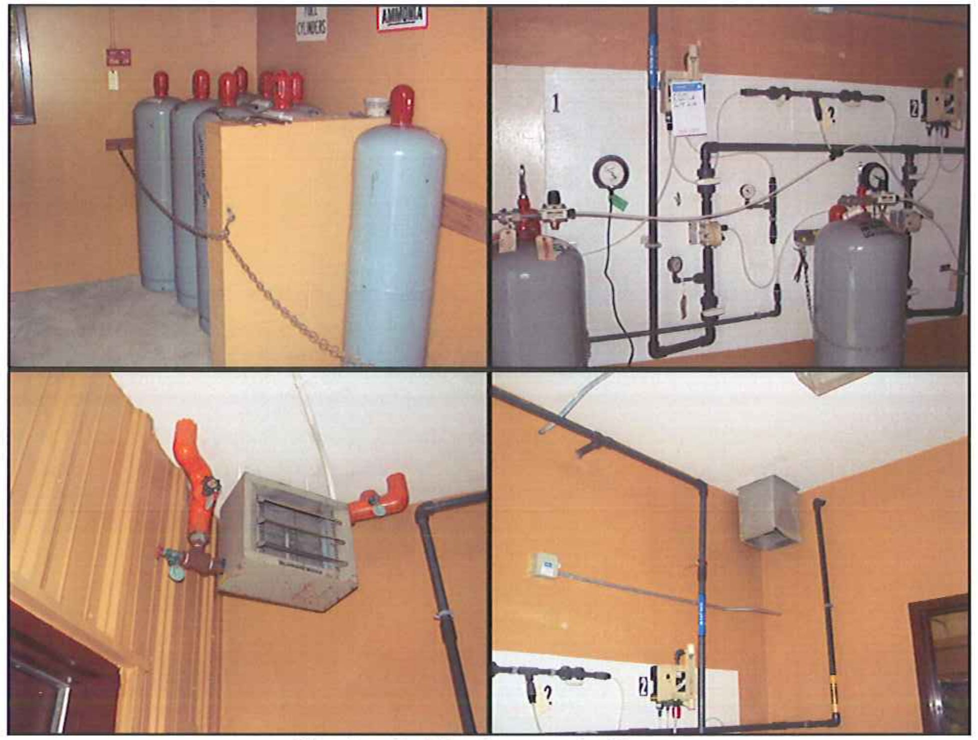


**Photo 4-11:** Ammonia Room


**Photo 4-12:** Polymer Feed Pump Location

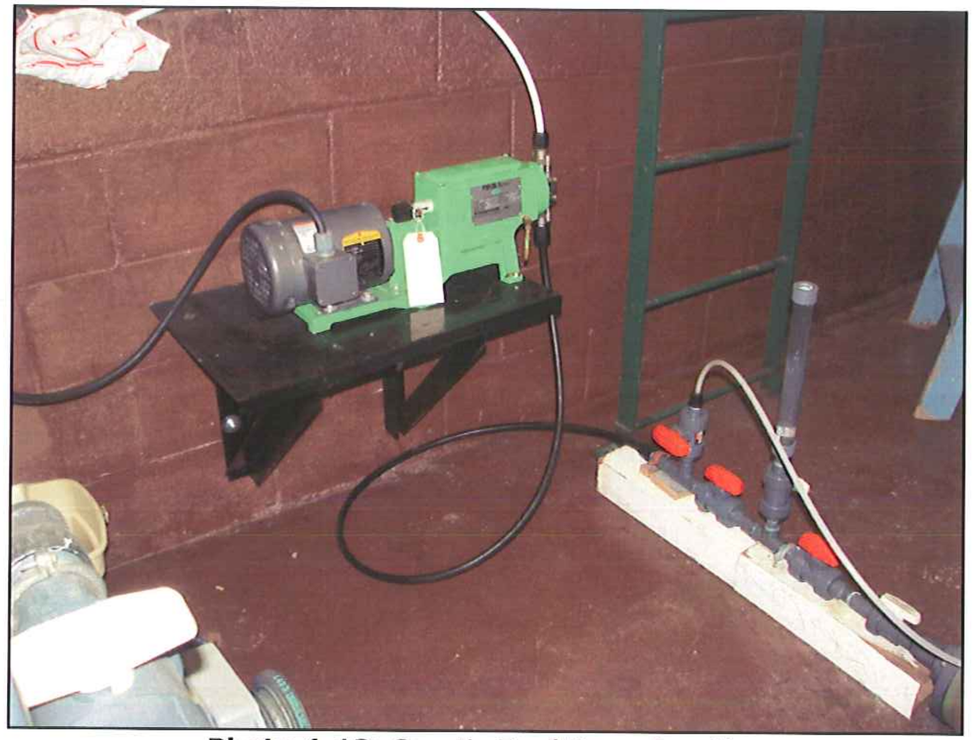


**Photo 4-13:** Caustic Feed Pump Location

## 4.6 UV Primary Disinfection

The feasibility of installing a UV system was evaluated in 2004 in the *Centennial Water Treatment Plant Options – Phase 1 Conceptual Evaluation*. UV disinfection would effectively deactivate *Giardia lamblia*, but is less effective for deactivation of viruses. Virus deactivation, however, requires substantially less disinfectant compared to *Giardia lamblia* inactivation. The concept is to install a UV unit on the filter effluent line upstream of the clearwell. The UV unit would provide primary disinfection.

Installing a UV reactor would modify the chemical disinfection strategy. Currently, chlorine is fed at the upstream end of the chlorine contact chamber. Primary disinfection is provided by free chlorine. Ammonia is added at the downstream end of the chlorine contact chamber, resulting in the formation of chloramine which provides a disinfectant residual in the clearwell basin and the distribution system. Under the proposed UV disinfection strategy, the point of ammonia addition would be moved to the upstream end of the existing chlorine contact basin, forming chloramine in the water entering the chlorine contact chamber. Since chloramine forms TTHM and HAA5 more slowly and to a lesser extent than free chlorine, implementing UV disinfection is expected to significantly decrease TTHM and HAA5 formation. Design parameters for the proposed UV system are as follows:

- Number of lamps: 4
- Type of lamps: high intensity medium pressure
- Maximum flow rate: 1.5 mgd (nominal plant capacity)
- Disinfection performance: minimum 1.0 log Giardia inactivation
- Redundancy: one unit provided – disinfection redundancy will be provided by the existing free chlorine disinfection system. Free chlorine disinfection would be

initiated by turning off the ammonia feed at the upstream end of the chlorine contact basin.

- Assumed filtered water quality: minimum UV transmittance (UVT) of 80%

In order to provide regulatory "credit" for primary disinfection, state and federal regulations require validation of the UV disinfection equipment. Validation may be performed either on or off site. Under the off-site validation approach, the vendor typically determines "validated" UV doses for various log-removal requirements under various hydraulic and UVT conditions for a particular disinfection system model. These test results form the basis for "off the shelf" documentation of the equipment that can be used to fulfill the regulatory submittal requirements. In order to use the off-site validation approach, the hydraulic and water quality conditions experienced by the installed unit must be similar (or better) than the tested conditions. On-site validation is expensive; the testing and documentation required by the regulatory agencies is significant. Off-site validation is significantly less expensive and is generally preferred for this reason.

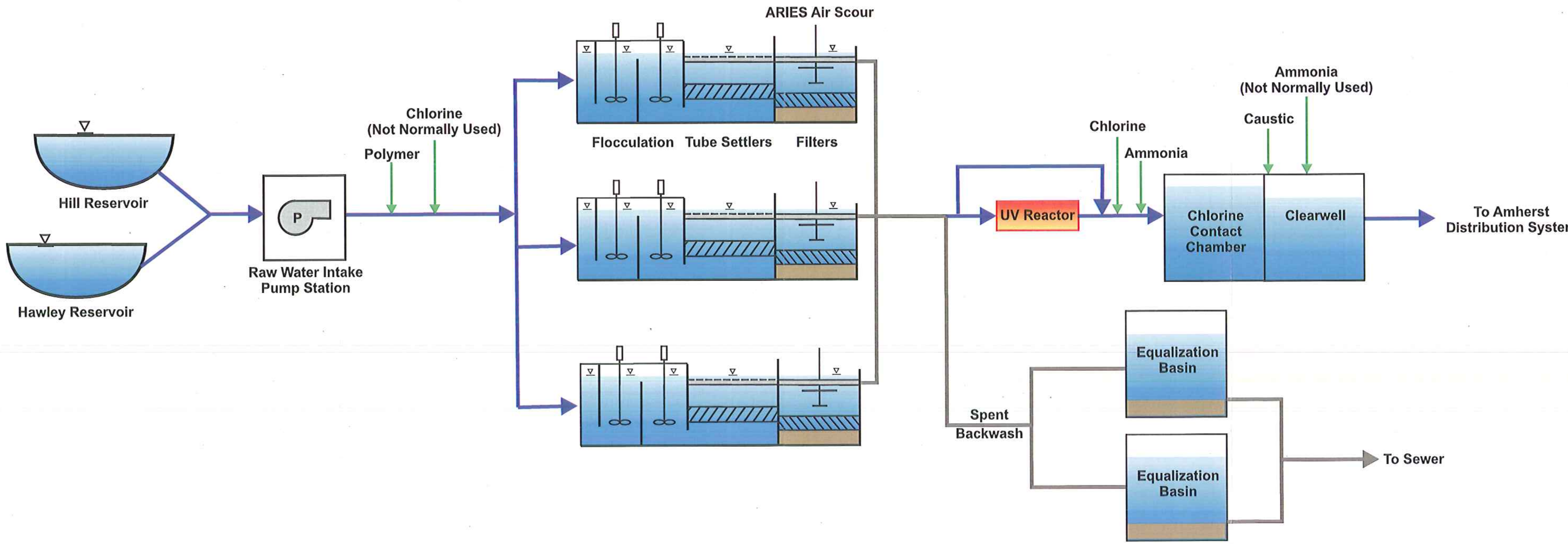
The proposed UV system will require modification of the filter effluent piping between the filters and the chlorine contact chamber (Photo 4-14) in order to combine the flow from the three filter units and provide an adequate length of straight pipe upstream of the UV unit. A UV system bypass will also be provided. The layout of the proposed system is depicted in Figure 4-6. Vendor information is available in Appendix E.

**Photo 4-14:** Location of UV Reactor modifications

## 4.7 Sewer Connection and Equalization Tanks

Minimizing sludge production has been a driver for the operation of the Centennial WTP and has limited options for coagulant use. One reason sludge production must be minimized is because of the small capacity of the settling lagoon system, which consists

# Figure 4-6
## Centennial Water Treatment Plant
## Proposed Process Schematic

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of two unlined earthen bermed basins connected in series. Backwash water is discharged to the upstream basin. The upstream basin overflows to the downstream basin, and the downstream basin overflows to Harris Brook. The solids are removed from the basins using a loader at intervals of approximately two years. The capacity of the washwater basins to receive residual solids is limited, thus limiting the amount of coagulant that can be utilized in the treatment process.

In order to remove this limitation, installation of a sewer line in Amherst Road connecting to the Amherst sewer system in Pelham Road is recommended. The Town of Amherst is planning to design a sewer extension into Pelham during the winter of 2010/2011. The existing sewer in Pelham Road is an 8" diameter line. In order to prevent overloading the existing sewer, equalization tanks at the Centennial WTP are proposed. A review of the plant's production records for July 2010 indicated that the maximum amount of waste water produced during a 24 hour period was approximately 77,000 gallons. Two buried precast storage tanks with a combined capacity of 80,000 gallons are proposed. The tanks would be located at the site of the existing upstream lagoon.

In addition to the equalization tank installation, the existing septic system would be abandoned and a new connection would be installed between the plant and the sewer.

Figure 4-7 presents a GIS layout of the proposed system.

## 4.8 Raw Water Pump Station

The existing raw water pump station pumps water from a 16-inch transmission main from the Hill and Hawley Reservoirs, east of the Centennial WTP. Water from the pump station is transferred to the WTP via a 12-inch force main. The pump station is a 22'-6" by 26'-6" building located west of the WTP and is equipped with three pumps. Two of the pumps have variable speed drives. The pump station is generally in good condition. We recommend connecting the variable speed pumps to the SCADA system by feeding a fiber optic cable from the raw water pump station to the water treatment plant via an existing conduit.

A new electric heater was installed recently; therefore, a heating equipment upgrade is not necessary. However, the existing roof-top ventilation equipment is worn and dented and replacement is recommended. We also recommend replacing the motor control center, which is now oversized.

## 4.9 Valve Pit Replacement

Water from the Centennial Water Treatment plant is delivered to Amherst via a 12-inch water main that is located along Amherst Road in Pelham. A flow control vault is located alongside the Pelham Town Hall, at 351 Amherst Road in Pelham. The flow control vault contains a pressure reducing valve (PRV) and a jockey pump. The hydraulic grade upstream of the PRV is set by the water level in the plant's clearwell. The PRV reduces pressure to match the hydraulic grade in the Amherst system. Upstream of the PRV, approximately 33 houses, the Town Hall, and the Elementary School located on Amherst Road, South Valley Road, Jones Road, and Cadwell Street are supplied at the hydraulic grade of the plant's clearwell. During periods when the Centennial WTP is not running, the jockey pump transfers water to this high pressure zone from the Amherst hydraulic


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**Legend**

- Manhole
- Proposed 8" sewer
- Parcels

0 300 600 Feet

1 inch = 500 feet

# FIGURE 4-7 PROPOSED SITE IMPROVEMENTS

**Pelham, Massachusetts**

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It is recommended to replace the flow control vault with a package pump station that contains a PRV, a flow meter, and a redundant 10 gpm capacity pump system. Flow data from 2002 through 2004 was analyzed and the data indicated that the neighborhood demand averaged 5 gpm. Assuming a peaking factor of 2.5, the maximum daily demand is estimated to be 12 gpm. Water that is pumped that exceeds the given demand at any one moment will fill the Centennial WTP clearwell, which acts as an equalizer for the existing pump, removing need for VFD controls on the pumps. A 20 gpm pump would allow for future build-out, as many of the houses in the neighborhood are not served by public water. Table 4-3 presents the flow estimate with the potential build-out estimate. Figure 4-8 presents the build-out for the Pelham High Service area, identifying houses that are currently served by the Town, and houses that could potentially be served in the future. Additional information is included in Appendix F.

**TABLE 4-3**
Estimated Demand for High Service Zone

| | Houses | Average Daily Demand (gpm) | Maximum Daily Demand (gpm) |
|---|---|---|---|
| Actual | 34 | 4.6 | 11.4 |
| Projected | 53 | 7.1 | 17.8 |

A prefabricated steel pump station including heat and dehumidifier, two 20 gpm pumps, PRV and controls, magnetic flow meter, and appurtenances is assumed. The station would be connected to the SCADA system by fiber optics cable that would be installed in conjunction with the proposed sewer.

## 4.10 LEED

We evaluated the potential to achieve Leadership in Energy and Environmental Design (LEED) certification as part of the project. The US Green Building Council revised the LEED rating systems in 2009, resulting in a system in which there are 100 possible base points plus additional points for Innovation in Design and Regional Priority credits. Buildings can qualify for one of four levels of certification:

- **Certified** - 40 - 49 points
- **Silver** - 50 - 59 points
- **Gold** - 60 - 79 points
- **Platinum** - 80 points and above

Points are distributed across credit categories including Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation in Operations, and Regional Priorities. Prerequisites in most categories receive no points, however are mandatory for all projects.

Based on review of the project scope, various potentially applicable LEED rating systems, and LEED minimum program requirements (MPR), it was determined that the

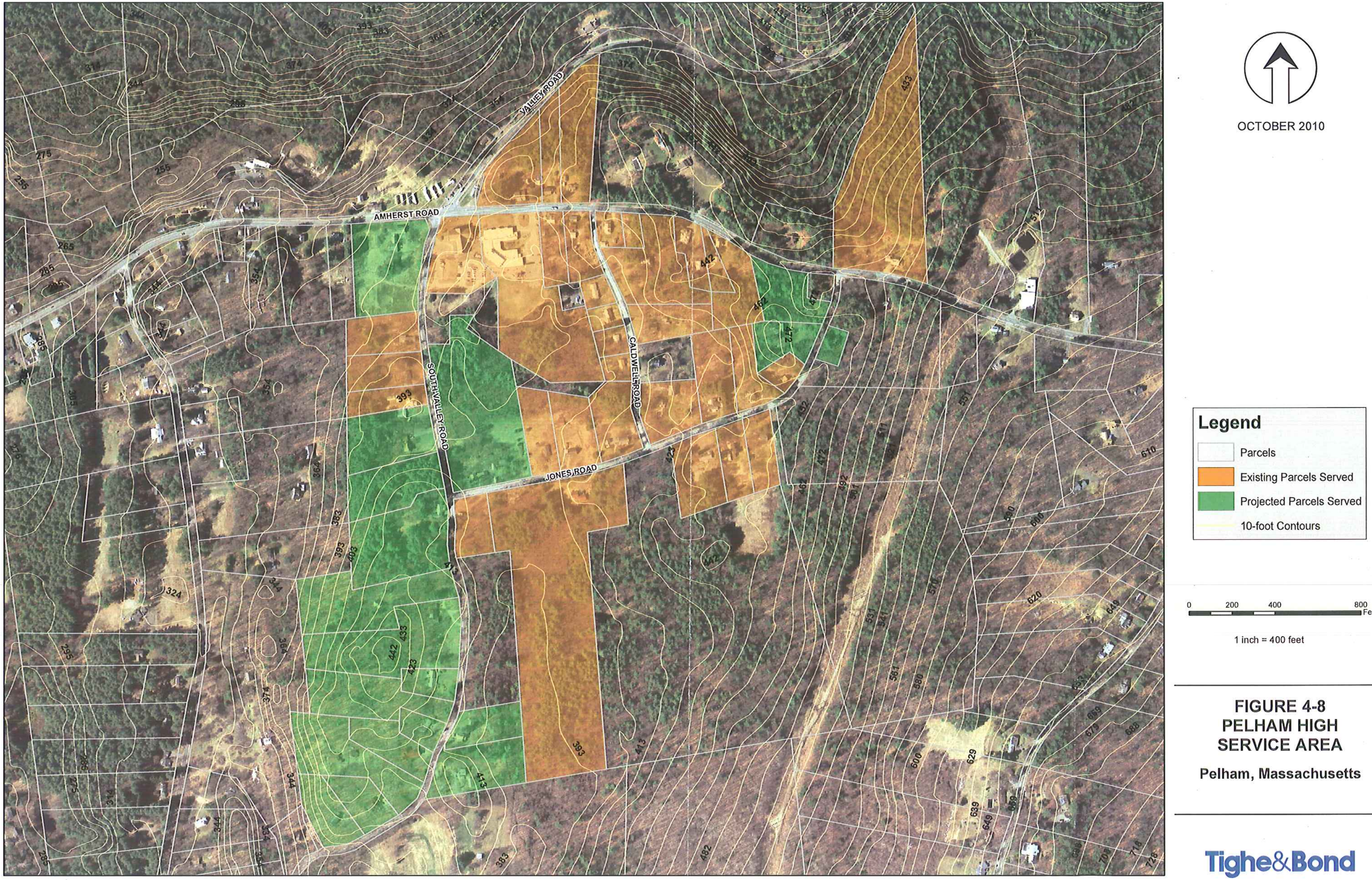


**FIGURE 4-8**
**PELHAM HIGH SERVICE AREA**

**Pelham, Massachusetts**

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LEED 2009 Existing Building: Operation & Maintenance (EBOM) rating system is the most appropriate for this project. For this evaluation, the MPRs, certification prerequisites, and credits were reviewed (in this order) to determine if project parameters would result in the project not being able to attain certification.

Information regarding the potentially attainable LEED credits is available in a memorandum in Appendix G.